J Indian Bot Soc 68 (1989)

Embryological Studies in a Few Taxa of Asclepiadaceae

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(Accepted January 1988)

Embryology of *Asclepias syriaca* Linn., *Sarcostemma brunonianum* W. & A, and *Telosma pallida* Craib. was investigated. Anther wall development was of the dicotyledonous type and at maturity consisted of epidermis, fibrous endothecium, 2-3 middle layers and a secretory tapetum. Tapetum was uniseriate and uninucleate but biseriate in *T. pallida* and was dual in origin. Fibrous endothecium was absent in *A. syriaca*. Pollen mother cells underwent successive divisions and produce linear tetrads. Cytokinesis was by cell plate formation. Pollen was 3-celled at shedding. Translator development was investigated. Corpusculum arose from the secretions of stigmatic cells and retinaculum appeared from the lateral extensions of the corpusculum.

Ovary was bicarpellary, apocarpous and bilocular with numerous anatropous, unitegmic and tenuinucellate ovules on marginal placentation. Hypodermal archesporium generally single celled and rarely 2-3 celled. Embryo sac development was of the Polygonum type. Rarely double embryo sacs were seen in *S. brunonianum*.

Key Words - Embryology Asclepidadeae *Asclepias syriaca Sarcostemma brunonianum Telosma pallida*

Asclepiadaceae is one of the economically important families of the dicotyledons. Embryologically, it is the only family (except Mimosaceae) in Dicotyledonae, where the pollen grains occur in packets. In the present investigation, embryology of a few members of the subfamily Cynanchoideae, *Asclepias syriaca* Linn., *Sarcostemma brunonianum* W. & A and *Telosma pallida* Craib. has been studied.

MATERIALS & METHODS *T. pallida* and *S. brunonianum* were collected by the author at Simhachalam and Kotappakonda hills of Andhra Pradesh respectively. *A. syriaca* was collected from the Indian Botanic Gardens, Howrah. All the materials were fixed in formalin-acetic acid-alcohol. Customary methods of dehydration, infiltration and embedding were followed. The sections were cut at 5-13μm thick and stained in Delafields haematoxylin.

OBSERVATIONS Microsporangium, microsporogenesis and the male gametophyte The anther is bilocular in the plants, a characteristic feature of the subfamily Cynanchoideae. The hypodermal archesporium consists of a plate of 6-8 cells and each row is 10-12 cells deep (Fig. 1A). The archesporial cells divide periclinally forming an outer primary parietal and an inner primary sporogenous layers. The former undergoes one more periclinial division giving rise to two layers of cells (Fig. 1B) of which the inner directly develops into the tapetum (Fig. 1C) and the outer, after a few periclinal divisions, give rise to 2-3 wall layers (Figs. 1D, 2A). Except in *A. syriaca*, the subepidermal layer of others develop fibrous thickenings and forms the fibrous endothecium (Fig. 1E). In *T. pallida* the fibrous thickenings extend to the adjacent cells resulting in a multilayered structure (Fig. 1E). The tapetum is of the secretory type. It is uniseriate in *S. brunonianum* (Fig. 2A) and biseriate in *T. pallida* (Fig. 1D). A part of the tapetum is also differentiated from the connective tissue and hence the tapetum is dual in origin (Figs. 1D, 2A). The primary sporogenous cells directly function as the pollen mother cells (Figs. 1C, D, 2A). They become

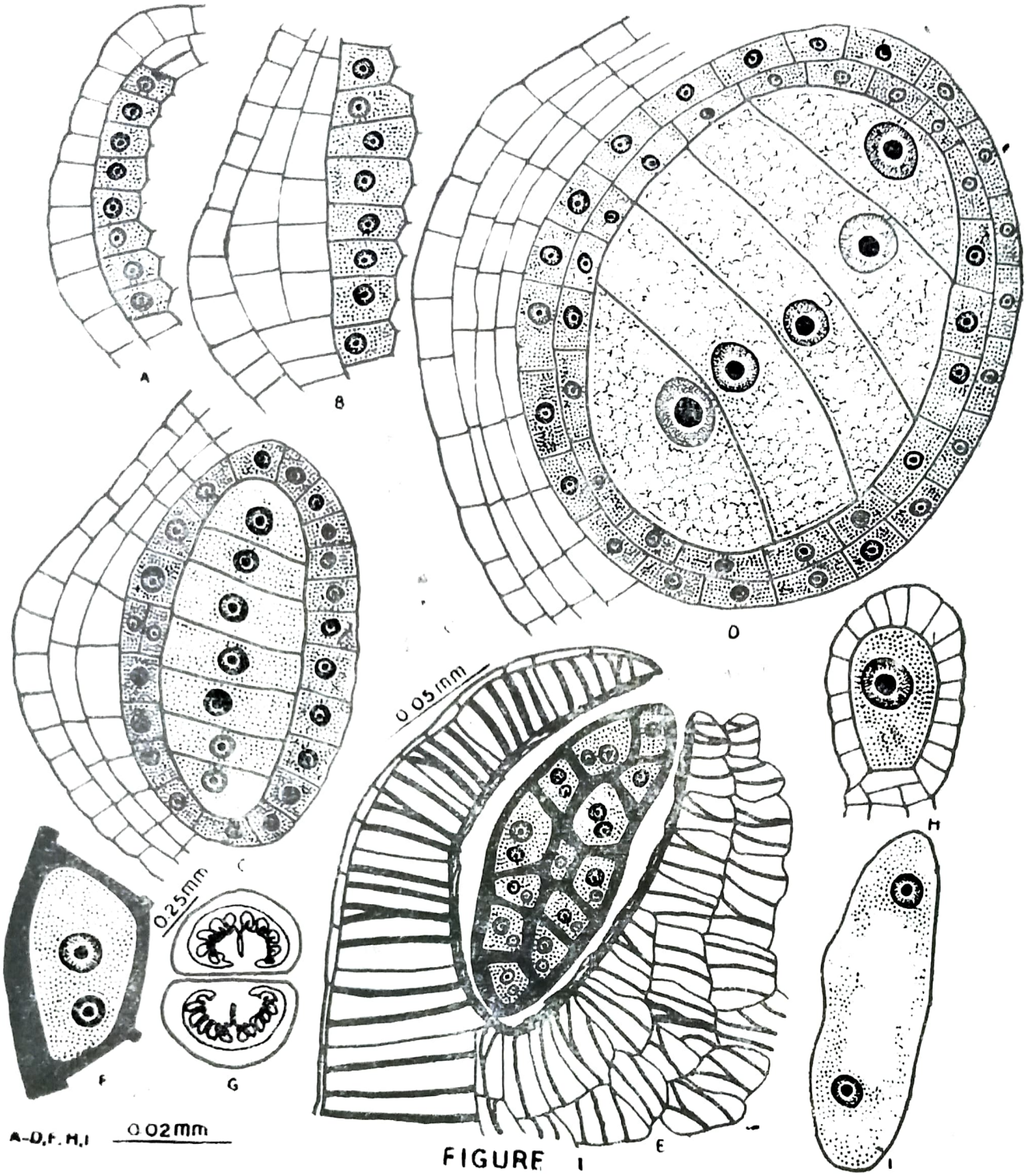

FIGURE 1

Fig 1. A - I. *Telosma pallida* A. T s of anther showing archesporium. B . T s. of anther showing primary sporogenous layer and parietal layers. C. Ts. of anther showing primary sporogenous cells, tapetum and wall layers. Note the tapetum from the connective side. D. T s. of anther showing pollen mother cells, biseriate tapetum and wall layers. Note the biseriate tapetum from the connective side. E. Ts. of anther showing fibrous endothecium and pollinium. Note the multiple fibrous endothecium from the connective. F. 2-nucleate pollen grain G. Ts. of ovary. H. Nucellus showing megaspore mother cell. I. 2-nucleate embryo sac.

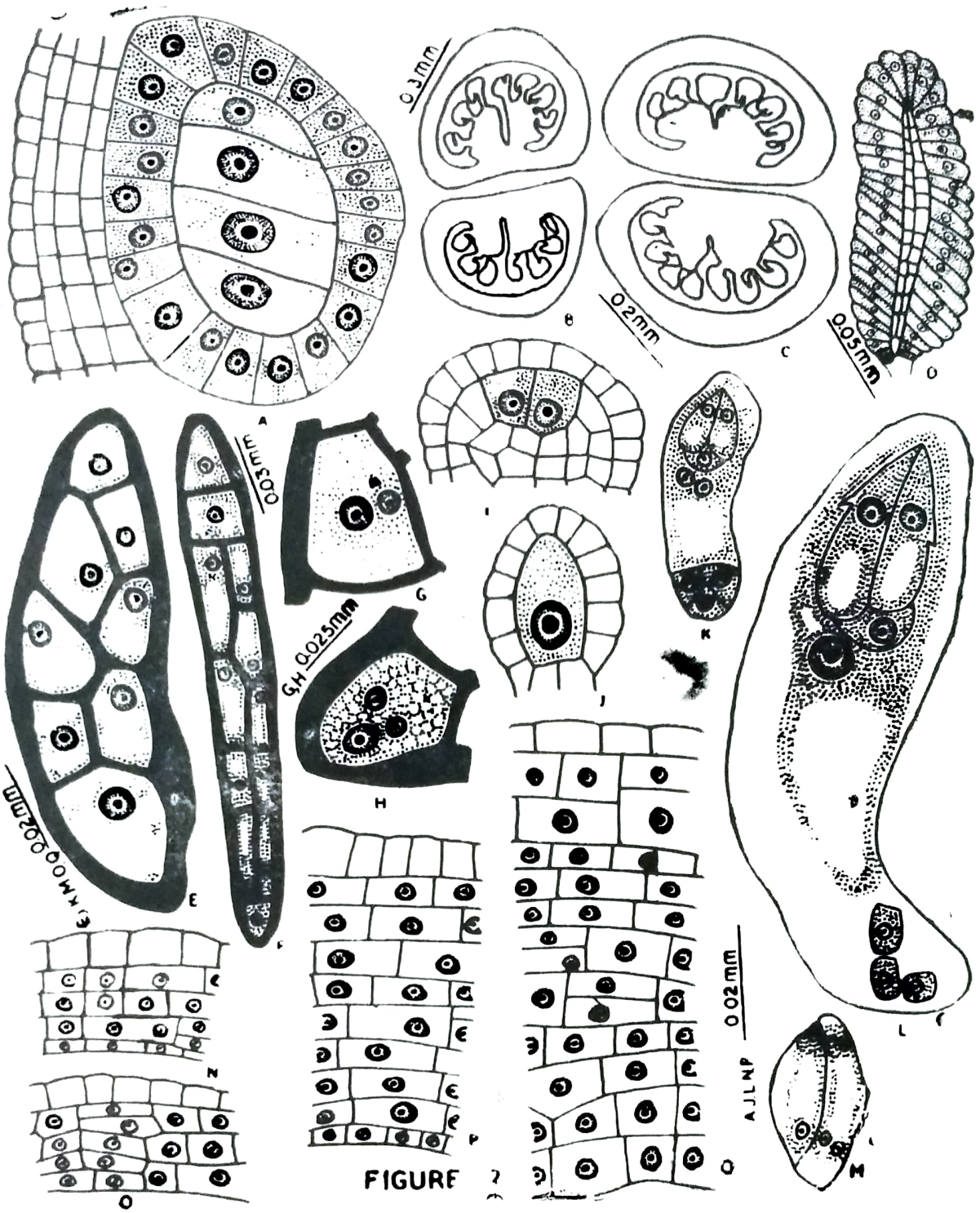

Fig 2. A - Q A, B, D-F, I, K, M, O, Q : *Sarcostemma brunonianum*. C, G, H, J, L, N, P : *Asclepias syriaca*. A. Ts. part of anther lobe showing pollen mother cells, tapetum and wall layers. B. & C. Ts. of ovaries. D. Squamella enlarged. E, & F. Pollinium in Ts. & Ls. of anthers respectively. G. & H. 2 & 3 nucleate pollen grains respectively. I. Ovule showing 2 archesporial cells. J. Ovule showing megaspore mother cell. K & L. Mature embryo sacs. M. Twin embryo sacs. N & O. Integument at mature embryo sac stage. P & Q. Ovary wall at mature embryo sac stage.

sq squamella.

elongated and develop vacuoles in them. The meiotic divisions proceed in a successive fashion and they are synchronous in all the sporocytes of a locule. Cytokinesis is by cell plate formation. The pollen tetrads are linear initially, but during the formation of the pollinium, their shape is altered due to the mutual pressure (Figs. 1E, 2E, F).

The nucleus of the uninucleate pollen grain divides mitotically and gives rise to a large vegetative and a small generative nuclei (Figs. 1F, 2G). The latter undergoes one more mitotic division to produce two male cells (Fig. 2H). Thus the pollen grains are liberated in a 3-celled condition.

The translator development in the plants is exactly similar to *O. esculentum* and *C. adscendens* (Maheswari Devi & Lakshminarayana, 1977, 1978). The corpusculum is formed from the secretions of the cells of stigmatic ridge and the retinaculum is formed exclusively from the lateral extensions of the corpusculum.

Megasporangium, megasporogenesis and the female gametophyte The ovary is superior, and consists of two distinct carpels, two styles and a common five-lobed stigma. The ovules are numerous and developed on marginal placenta (Figs. 1G, 2B, C). In *S. brunonianum*, squamellae consist of central core of cells surrounded by a peripheral layer of glandular cells (Fig. 2D). The ovule is anatropous, unitegmic and tenuinucellate. Generally, the archesporium consists of a single hypodermal cell which directly functions as the megaspore mother cell. Occasionally in *S. brunonianum*, 2-3 archesporial cells are differentiated (Fig. 2I). But one of them develops further into the megaspore mother cell (Figs. 1H, 2J). A linear tetrad of megaspores is formed consequent upon the usual meiotic divisions in the megaspore mother cell. The chalazal megaspore of the tetrad develops into an 8-nucleate embryo sac of the Polygonum type (Figs. 1I, 2K, L). The embryo sac is more or less cylindrical in *S. brunonianum* (Fig. 2K) while it is elongated and broader in the micropylar end and slightly curved and narrower in the chalazal end in *A. syriaca* (Fig. 2L). The egg apparatus consists of an egg and two pear-shaped synergids. The synergids are hooked in *A. syriaca* (Fig.2L). The two polars meet at the middle of the embryo sac and fuse before fertilisation. The antipodals are three in number and are uninucleate. Rarely double embryo sacs are observed in *S. brunonianum* (Fig. 2M). They show different developmental stages and are probably developed by the further functioning of more than one archesporial cell.

Integument and Ovary wall The integumentary primordium arises after the differentiation of the archesporium in the ovule. The single integument grows very rapidly, becomes 5-6 layered (Fig. 2N,O) and covers the nucellus completely at the mature embryo sac stage.

The ovary wall at the mature embryo sac stage consists of 10-12 layers of cells in *A. syriaca* (Fig. 2P) and 12-15 layers in *S. brunonianum* (Fig. 2Q). The cells are parenchymatous and uninucleate.

DISCUSSION In the present study fibrous endothecium is present in *T. pallida* and *S. brunonianum* and absent in *A. syriaca*. Similarly absence of fibrous endothecium is reported in *Calotropis gigantea* and *Oxystelma esculentum* (Maheswari Devi, 1964; Maheswari Devi & Lakshminarayana, 1977). The tapetum is of the secretory type and is uniseriate in *S. brunonianum* and *A. syriaca* but biseriate in *T. pallida*. The tapetal cells are uninucleate. But Maheswari Devi (1964) reported multiseriate tapetum with uninucleate cells in *Cynanchum callialata*, *Pergularia daemia* and *Tylophora asthmatica*. Mulay

et al (1965) reported uniseriate tapetum with multinucleate cells in *Tylophora cordifolia*, *Pentatropis spiralis* and *Leptadenia reticulata*. Maheswari Devi & Lakshminarayana (1977) reported multiseriate tapetum with multinucleate cells in *O. esculentum*. In the present study the tapetum is found to be dual in origin, not reported in Asclepiadaceae. Although Rao & Rao (1954) stated that in *Cryptostegia grandiflora* "all the cells of the connective situated in the concavity of the sporogenous mass function as the tapetum, so that it is multiseriate at this region" -they could not recognise it as the connective tapetum.

The translator mechanism is peculiar among the subfamily Cynanchoideae of the family Asclepiadaceae. Its presence distinguishes the Cynanchoideae from the Periplocoideae. About the formation of translator, different views have been expressed (Woodson, 1941; Rao & Rao, 1954; Biswas, 1957; Maheswari Devi, 1964). I found that the corpusculum is formed from the secretions of the stigmatic ridge and the retinaculum is formed exclusively from the lateral processes of the corpusculum. In this respect it is similar to *O. esculentum* and *C. adscendens* (Maheswari Devi & Lakshminarayana, 1977, 1978).

According to Dop (1903) in *Asclepias* the ovule is without integument. But *A. syriaca* shows a well developed integument (present study). Frye (1902) and Guignard (1917a,b) reported a rudimentary nucellus in *Asclepias*. This study on *A. syriaca* has revealed a well developed nucellar epidermis around the megaspore mother cell. Such a well developed nucellar epidermis was reported by Maheswari Devi (1964) and Mulay *et al* (1965).

Presence of scale-like, glandular and non-vascular squamellae, similar in appearance to those of Apocynaceae is seen. But they arise from the thalamus in positions alternating with the sepal lobes and not from the calyx as in the Apocynaceae.

Occasionally 2-3 archesporial cells and presence of double embryo sacs are observed in *S. brunonianum* as in *Calotropis procera* (Sabet, 1931). However, in *Ceropegia juncea* (Maheswari Devi, 1964), *Asclepias* (Frye 1902) and *Araujia* (Guignard, 1917 b) 2 archesporial cells have been reported in an ovule, but only one of them develops further into the megaspore mother cell.

In most of the cases, including the present study the embryo sac development is of the Polygonum type. But Chauveaud (1892) and Seefeldner (1912) reported Lilium and Scilla types of embryo sac development in *Vincetoxicum* and *Cynanchum vincetoxicum*, respectively. The occurrence of three uninucleate antipodals is a common feature in this family. However, in *Asclepias*, Frye (1902) reported occasional occurrence of more than three antipodals. In *Caralluma* (Rao & Rao, 1954), *Ceropegia juncea*, *Cynanchum calliata* (Maheswari Devi, 1964), the antipodals simulate the egg apparatus.

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